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A Classroom Pond

Survival Techniques

Biology in Denmark

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COVER PHOTOGRAPH

Bee on sage blossom, taken by Ron Lenhart, student at Mesa High School, Mesa, Arizona. The picture was shot with a 4x5 Speed Graphic, f16 at 1/200 of a second, on Super Panchro-Press Type B film. His biology teacher is Dorothy Shouse.

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A "Natural Pond" in the Classroom

HERBERT R. TREUTING JR., and
HOWARD M. FUHRMAN
State Teachers College, Trenton, N. J.

All too frequently the teacher of biology fails to take full advantage of the aquarium as a teaching aid. He is content merely to stock it with various forms of fish and plant-life and then permit it to gather dust along with the rest of the bizarre, and sometimes pedestrian, conglomeration, so typical of many biology classrooms. The tank then becomes a relatively sterile piece of apparatus which only now and then catches the eye of the student. It is the purpose of this article to show how a series of aquaria can be used as a continuum of *dynamic* and *living* biology in the classroom.

The basic material in this article, originally suggested by C. Dudley Hughes, has been modified somewhat by the authors, and will be presented in essentially two phases; i.e., the physical setup of the "natural pond," and its biological interrelationships.

The definition of the word *pond* is controversial; it varies with each authority. The distinction, for example, between lakes and ponds is a difficult one at best and of necessity, an arbitrary one. Some hold that the true difference between them is one of *depth* and not area. According to this concept, a pond is a shallow body of standing water, devoid of thermal strata, in which relatively quiet water and extensive plant and animal occupancy are common characteristics. No matter what the definition, however, a pond presents to the student of biology, young or old, a fantastically absorbing aquatic world of interest.

The fact that so many of our classrooms are located far from ponds and lakes, has provided a need which aquaria, if properly managed, can fulfill. The purpose of this article is to present a system of eight interconnected tanks that functions biologically almost exactly like a natural pond. It is designed to not only house the variety of flora and fauna commonly found in any pond environment, but to provide the necessary conditions that will permit growth and reproduction. Once established, it will provide an almost constant source of living specimens of nearly all the major and minor phyla of the plant and animal kingdoms. No longer will the teacher need to depend upon his usual collection of preserved corpses; he will have a supply of living organisms with which to teach the science of living things. For example, the "classroom pond" here at Trenton, at its last census, was supporting a variety of species representing eight major and two minor animal phyla. In the classes Crustacea and Insecta alone, there were eleven orders represented.

Any body of water supporting a variety of living organisms obviously must be meeting their needs. This article will not attempt to consider every aspect of the metabolic cycles occurring in ponds. It will attempt rather to focus on such things as the problem of oxygen, food chains, and the fate of dead organic materials in ponds as met and solved within the restricted confines of the "classroom pond."

Although this system consists of eight tanks, actually only two constitute the "heart" of the system, i.e., Tanks 4 and 5. The remaining six serve as specimen tanks. Tank 4 may be regarded as the "sewage works." Into it enters the water that has completed the route through the other seven, laden with organic wastes. These wastes consist of such materials as feces of animals and particles of dead plant and animal tissues. Scavengers, such as Tubifex, Cypris, Gammarus, Planaria, and Asellus, purposefully placed in this tank, feed on the wastes, reducing their particle size to a form called detritus. This activity sets the stage for the all important phases of decomposition and putrifaction carried on almost exclusively by the bacteria. The end products of these phases are dissolved organic and inorganic compounds so essential to the growth of the phy-

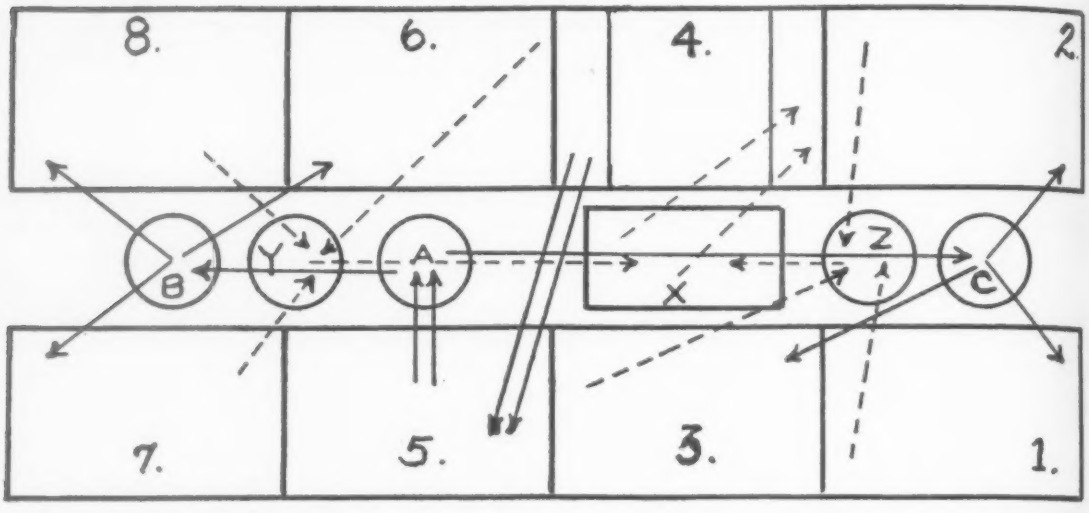

FIGURE 1. Diagram of the physical setup of the "classroom pond." The solid lines represent the distributing siphons and the broken lines, the drainage siphons with the arrow heads indicating the direction of flow.

toplankton, substrate algae and rooted aquatics. The phytoplankton are the basic links in the food chains of any body of water supporting animal life.

These activities, although absolutely necessary to a balanced environment, contribute to situations endangering the existence of the very organisms on which the scavengers and bacteria depend. For example, the concentration of oxygen is so drastically reduced, as a result of the decomposition of organic material and the respiration rate of the scavengers, as to preclude the existence of the aerobic forms. Furthermore, many of the by-products of decomposition and putrifaction, i.e., carbon dioxide, methane, organic acids, ammonia etc., are toxic to not only the inhabitants of the "sewage works" but to the inhabitants of the whole system as well. In order to prevent this from happening, the water is circulated next to Tank 5 and then through distributing sumps, to the rest of the system.

In Tank 5, a drastic reduction in the carbon dioxide content of the water occurs along with a corresponding elevation in the concentration of oxygen. Such aquatic plants as *Vallisneria spiralis* and *Sagittaria natans* are responsible for this reversal. Both types are vigorous growers and as a result of their photosynthetic activity, they consume great amounts of carbon dioxide, releasing as a by-product, oxygen. Because some of the organic material passing through Tank 4 is not completely reduced, scavengers are introduced into Tank 5 to complete the process, and also to consume any leaves that begin to rot in the jungle of oxygenators.

It must be remembered that this important function, i.e., the reversal of the relative concentrations of carbon dioxide and oxygen, occurs only during periods of light. At night photosynthesis ceases, while both plant and animal respiration continues. This problem may be easily solved by the simple device of artificial illumination.

The toxic substances released principally by the anaerobic forms in the "sewage works" are oxidized here and utilized, depending on their nature, as sources of energy or repair materials. In this way the water becomes purified and revitalized for further use in the rest of the system.

Two of the other six specimen tanks warrant discussion here. If this system is to exist as a self-contained unit, as the pond does in nature, then attention must be paid to particular members of the food chains. Certain Crustacea are vital links in these chains; e.g., Daphnia and Cyclops. Tank 1 was selected as the breeding ground for these forms. Daphnia and Cyclops are constantly circulating through the system, destined to become gastronomical tidbits for their predators. Uncontrolled circulation within the restricted

Photograph of the "classroom pond." The tank with the partially submerged bulb in the lower center of the picture is Tank 1, used to breed Daphnia.

The tank in the lower left portion of the picture is Tank 8 and is designed to house the larval and adult forms of the Insecta. Note the glass chimneys resting in beakers filled with coarse pebbles.

confines of this system could lead to their extinction. This problem, fortunately, is easily solved. Since Daphnia are positively phototropic, a light bulb placed at the end of the tank opposite the drainage siphon will attract enough to guarantee a reproductively perpetuating stock. The light bulb will also stimulate the growth of algae and protozoans assumed to be the chief foods of Daphnia and Cyclops.

The other tank, No. 8 in our system, is designed to house the larval and adult forms of the class Insecta. It is important to isolate this tank from the rest of the system for two reasons: 1) many insects are predaceous and have been observed attacking tadpoles and fish many times their size; 2) others are almost completely defenseless and serve as links in the food chains of fish. In order to isolate this tank and at the same time permit free circulation of water, the drainage and distributing siphons are placed in glass chimneys which rest in glass jars or beakers filled with coarse pebbles. The pebbles should be large enough to permit relatively free passage of those food forms raised in Tank 1.

In the physical setup of the "classroom pond," several problems were encountered in trying to duplicate Mr. Hughes' original plan. His plan called for eight ten-gallon tanks arranged in one unbroken line with the drainage and distributing sumps placed between specific tanks. This arrangement would require an estimated length of 25 feet of shelf or table space, making it almost prohibitive for the average classroom. To overcome this disadvantage, the tanks were arranged in two rows of four tanks each, with the drainage and distributing sumps located between the two rows. (See Fig. 1.) This new arrangement permitted a drastic reduction in the amount and lengths of tubing necessary to interconnect the tanks.

The sumps presented the next problem. Hughes specified glass containers of the same height as the tanks. Wishing to keep the cost at a minimum, it was decided to use one-gallon pickle jars for all the sumps except Sump X. These jars were shorter than the tanks. To eliminate this problem, a platform was constructed between the rows of tanks

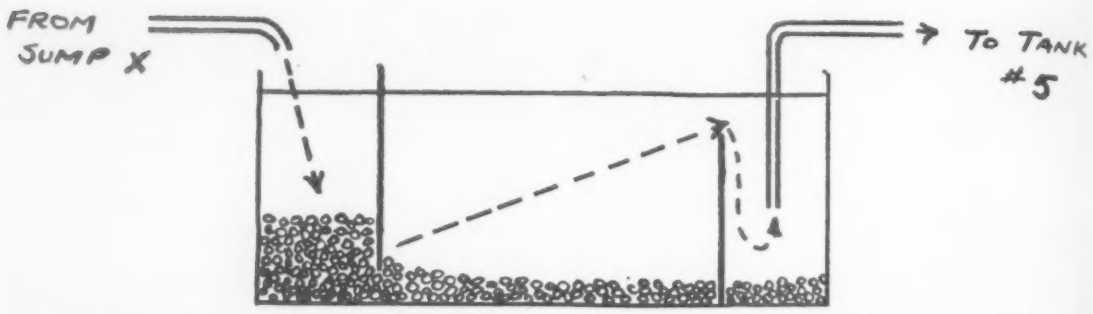

FIGURE 2. Diagram of Tank 4 showing the position of the baffle plates and the relative depths of the pebble bed.

of sufficient height to bring the tops of the jars on level with the tanks. Sump X, which in the original plan consisted of two separate sumps, was converted into a single large sump by using a small two-gallon tank which also had to be elevated in order to bring it level with the rest of the system.

To maintain a circulation of water throughout the system, an airlift was used to move the water from Sump X into Tank 4. This lift consists of two large glass funnels inverted in a bed of coarse gravel and connected by rubber tubing to Tank 4. Under each funnel a diffuser, or air stone, was placed and connected to an air source. The air rushing up the funnels, carries water with it, constantly reducing the level of water in Sump X. This reduction causes a movement of water into X from the drainage sumps Y and Z which in turn drains the water from the specimen tanks 1, 2, 3, and 6, 7, 8, respectively. The resulting head of water developing in Tank 4 causes a flow through the siphon into Tank 5 and out into the main distributing Sump A where it splits off via two siphons to Sumps B and C. These distributing Sumps carry the water to the specimen tanks 1, 2, 3, and 6, 7, 8, respectively, thus completing the circuit.

The siphons are constructed from glass tubing. The tubes from Sumps B, C, Y, and Z are one-half inch in diameter while the others are five-eighths. A double tube is used between Tanks 4 and 5, and 5 and Sump A. In each tank the drainage and distributing siphons are placed as far apart as possible with the distributing siphon opening near the top of the tank and the drainage siphon pulling off near the bottom.

Tank 4 has two baffle plates which divide the tank into three sections. The baffles are made from glass plates and are fitted into place with split rubber tubing in order to insure a snug fit. The plate nearest the rubber tubing from Sump X extends above the water line but does not come in contact with the bottom of the tank, while the other plate is in contact with the bottom and has its upper edge below the surface of the water. This arrangement permits the maximum diffusion of water as well as sedimentation. The bottom of this tank is layered with coarse pebbles in such a way that the section receiving water from Sump X has a pebble depth of six inches, while the other sections have a two inch bed of pebbles. (See Fig. 2.)

Although the initial establishment of the "classroom pond" requires a lot of work, it soon almost maintains itself. Aside from replacing water lost through evaporation and possibly adding specimens from time to time, the teacher may now devote his time and energy to building a study of biology around a living museum.

For the practical-minded teacher, perenially confronted with budgetary problems, this setup may be duplicated for $69.75. If an air source or perhaps a few used tanks are available the cost may be drastically lessened.

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Strategic Air Command Survival Techniques[1]

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Castle Air Force Base, California

Survival kit or pack.

Small animal trap.

The prerequisite for successful survival is the will to survive. The Strategic Air Command teaches its air crew members the ways of survival and attempts to induce the will. Since the establishment of our first SAC survival schools, the science of survival as it is taught to our crew members, has progressed rapidly. We now have excellent equipment and advanced ideas to meet the challenges of nature. Air Force survival schools have been set up throughout the zone of the interior and in many areas overseas.

To teach survival is a hectic and oftentimes enervating ordeal. Good survival instructors are scarce, and when an individual with the aptitude is discovered, he is put through exhaustive training courses. His classroom may be a tent, a parachute platform, a stretch of desert, a mountain ridge, a stream of water or a wooded valley. He must do his instructing under whatever conditions Nature sends—snow, wind, rain, dust, broiling heat, or freezing temperatures. The period of survival training represents a valuable opportunity for the aircraft commander to evaluate the weaknesses and strengths of the men under his command, and it is the duty of the instructor to help in distinguishing these traits.

Let us begin a discussion of survival techniques by enumerating a few broad principles that will apply in most survival instances. The primary requirement for a successful survival effort is the ability of a man to provide himself with adequate quantities of food and water. In the survival diet meat is essential. Plant food may serve to relieve some of the hunger pains or aid in elimination, but meat provides the energy necessary to continue the trek. If the survivor is without water, it is recommended that he eat only foods with a high moisture content so as to prevent internal dehydration. Life can be sustained for a much longer period without food than without water. If there is a water shortage, it would be well to remember that fruits require

[1]Presented at the annual winter meeting of the *National Association of Biology Teachers*, Berkeley, California, December 26-31, 1954.

the least amount of moisture for digestion, starches next, and fat requires the greatest amount.

To obtain the game which will provide the meat for subsistence the survival student is taught the essential principles of stalking game; keeping off the skyline; keeping the wind in his favor; and searching the terrain in all directions, preferably with the E-1 Kit monocular.

The meat of all those animals with hair likely to be encountered by the survivor is edible. In the Arctic, however, the liver of the polar bear is to be avoided due to the large quantities of Vitamin A, which cannot be assimilated by the human system.

There are many ways to catch fish under survival conditions. One of the best of these methods is the use of poison, which in some environments can be readily obtained from natural sources. Rotenone, the most effective of fish poisons, in a small bottle of 12% solution, will kill fish for one-half mile downstream in a twenty-five foot wide stream. Quicklime from burned and crushed seashells can be used for poison in tidal pools along the coast. In South America, sap from the Sand Box tree is used for fish poison, while in the Southwest Pacific area, the crushed seeds and bark of the Barringtonia tree are utilized. Tidal traps, gill nets, or stream diversions are other ways of procuring fish for food. It is recommended that all fresh water fish be thoroughly cooked to eliminate any parasites.

Two of the better methods of catching birds for food are the Ojibway bird snare or nets. Sea birds, while not exactly desirable, can be made more edible by skinning rather than plucking.

A number of very general rules have been devised to enable men living under survival conditions to properly select plant foods with which to supplement their diets. These can be briefly summarized as follows: Flowers and ferns are usually edible, while bulbs should be avoided as they are often toxic. Fruits are generally good if they taste good. Mushrooms should be avoided as they have only slight food value and it is extremely difficult to differentiate the edible varieties. Furthermore, in some latitudes almost all mushrooms are poisonous. Plants with a bitter or milky sap should also be discarded. In regions where berries are plentiful the red-white-blue rule will serve with some success in selecting the edible varieties. White berries are often toxic; red half and half; and blue berries are most often suitable for human consumption. Any plant which the survivor sees a carniverous animal eating will also prove edible. Finally, if a man is in doubt about the salubrious qualities of a certain plant, he can resort to the standard edibility test: eat a teaspoonful and wait eight hours for ill effects. If none, try a handful and wait another eight hours. If there are still no ill effects as much as desired may be eaten.

One other item which we hope our crew members will remember in time of stress is this: if they are short of water after a crash landing or bailout, they are advised to wait twenty-four hours before drinking, because in their agitated condition water will pass right on through the body with little benefit.

Recent Air Force studies indicate that the body dehydrates at a uniform rate and that the practice of sipping small amounts of water during a period of shortage does not serve to increase the life expectancy of the survivor.

There are some portions of the world which are so characterized by extremes of topography, vegetation, or climate, that survival requires the ultimate in common sense, skill and equipment. The Arctic is a striking example of this type of environment. Many very serious difficulties can plague an individual improperly trained or ill-equipped attempting to live under survival conditions in the Arctic. Hypothermia, a condition existing when the body temperature is below normal, is a constant menace. Unconsciousness and death can result from a steady drainage of body heat without the actual freezing of any local areas. Treatment in the field should be initiated by getting the individual in some sort of makeshift shelter. Then apply heated stones or other material as close as practicable to the torso. In the treatment of hypothermia, as well as all other Arctic ills, alcohol should be avoided. It opens the blood vessels at the surface of the skin allowing heat to be lost even more rapidly.

Hypothermia is usually a prelude to frostbite, which is the actual freezing of living tissue. It first may be recognized by a feeling of numbness and, as freezing progresses, the surface of the skin becomes yellowish-white. Prolonged frostbite will lead to amputation or death. Overpowering drowsiness, induced by exhaustion or exposure, is the last clearly conscious signal that death is imminent. There is no reason to fear sleep, however, unless exhaustion is present. Normally a person will awaken if he becomes cold, long before freezing takes place. The first step, again, in treating frostbite is to get into a sheltered spot out of the wind. Use heated stones or other materials to thaw out frozen areas. Body heat of another person is ideal for an emergency. Use the armpits, hands, stomach or thighs as heat sources. Warm a frost-bitten area as rapidly as the patient can stand it. One common fallacy of treating frostbite has to do with rubbing snow on frozen tissue. This procedure will only hasten the freezing and may damage the tissue severely.

Snowblindness is a temporary form of blindness caused by the high intensity and concentration of the rays of the sun, both direct and reflected from the snow. First, the eyes become sensitive to glare; then blinking and squinting occur. Finally, a sensation similar to that of sand in the eyes is experienced, and vision is eventually blanked out as if by a flaming curtain. There is intense pain which may last for three or four days. To treat snowblindness, get the patient to a dark place or blindfold him. Time is the only cure, but cool compresses can help relieve the pain. The prevention of snowblindness is very simple. Standard rose colored glasses are recommended or, in an emergency, glasses fabricated from wood, cloth, or paper can be used. The aperture should be made small so as to restrict the number of sun rays striking the eyes.

Another hazard very prevalent in the Arctic is carbon monoxide poisoning. More people have died in the high latitudes from this poisoning than from freezing. It is caused by the incomplete combustion of synthetic fuels. Symptoms are headache, dizziness or nausea. Once again, prevention is simple; shelters should be properly ventilated at all times, especially when cooking.

Improvised shoe; lean-to in background.

Besides the Arctic, deserts and jungles also contain hazardous experiences for the survivor. The extremes of heat, dryness, water, vegetation and insects make it essential that men overflying these areas be well trained in survival.

The Strategic Air Command has a wide variety of efficient survival equipment which will usually fit into one of several broad categories: communications equipment, survival kits, or life raft kits.

For survival communications, SAC relies upon the small AN/URC-4 radio and the long range RS-6 radio.

Our primary survival kits are the A-1 for jet aircraft and the Global E-1 Kit for conventional aircraft. The E-1 Kit accompanies each individual crew member on bailout and is the most complete kit available. It weighs thirty-four pounds and contains such representative items as a sleeping bag, Hornet Rifle, one-man tent, eating utensils, snares, compass, first aid kit, rations and fishing kit.

To sum up this brief discussion on SAC survival techniques, it can be said that in addition to the will to survive, a man must have common sense and ingenuity. Often it is necessary for the successful survivor to overcome childhood fears of the outdoors, animals, snakes and strange noises.

Biological Control of Agricultural Pests

RICHARD L. DOUTT
Associate Professor of Biological Control
University of California

The use of natural enemies to suppress agricultural pests is called biological control. Its practical value was first demonstrated in California in 1889 in a very spectacular fashion. The citrus industry was then threatened with ruin from the ravages of the destructive cottony cushion scale. This insect was killing the trees and forcing the growers to abandon citrus as a commercial enterprise, but in the short period of one year the insect was completely controlled by a predaceous ladybird beetle imported from Australia.

The control of the cottony cushion scale is as complete today as it was when first accomplished in 1889, and this emphasizes the fact that biological control is permanent in its effects. Other advantages are that it is safe and economical. It is safe not only to the crops it is assigned to protect, but also to man and his domestic animals. There are no poisonous residues left on the crops and the farmer is not confronted with an annual expenditure of money for pest control.

Biological control is based on sound biological principles. It is well known that the great majority of agricultural pests are not native to America but have been accidentally introduced by man. When such species are traced back to their native home it is a common experience to find that there they are not abundant and cause no economic damage. Usually associated with them are natural enemies (parasites, predators, and pathogens) which keep the pest species suppressed. Basically, the procedures in biological control consist of searching for these natural enemies and importing them to America where they will attack the pest and restore it to the low level that it holds in its original home.

While biological control is most commonly employed in the reduction of insect populations, it also is used effectively against other agricultural pests such as snails and weeds.

For example, the islands of Micronesia became infested with the Giant African Snail during World War II. When this area came under the trusteeship of the United States after the war, our government undertook to protect the agriculture of the island people from these snail pests. From Africa, the native home of the snail, several natural enemies were introduced to the islands of Micronesia. Among these natural enemies were some predaceous snails which feed on the young of the Giant African Snail. Latest reports indicate that these imported predators have substantially reduced the numbers of the Giant African Snails on the test islands.

Weeds cause great losses to agriculture, particularly when they invade range land and replace the valuable grasses. Entomologists have found that such weeds can be controlled by introducing insects to feed on them. Great care must be taken to select insects which feed only on the weed and will starve before eating any other plant. This requires years of painstaking research, but the results are of tremendous value.

In Northern Australia millions of acres were invaded by an *Opuntia* cactus commonly called the prickly pear. These dense thickets of cactus made the land useless to agriculture, but in a short time the entire area was reclaimed by introducing from Argentina a cactus feeding moth which destroyed the cactus plants. Recently, in California, the noxious Klamath weed has been removed from hundreds of thousands of acres of range land by the work of beetles imported for its control. (Figure 1.)

It is known that insects are sometimes subject to disease epizootics which wipe out large numbers of pests. In recent years the use of such pathogens (fungi, bacteria, protozoa, and viruses) has been studied intensively in laboratories of insect pathology. It is now possible to initiate disease outbreaks among insect populations by applying sprays containing some pathogenic organism specific to the insect pest. This may be of tremendous value in the control of certain agricultural pests. For example, one problem on alfalfa is that the

FIGURE 1. Area in foreground is solid stand of Klamath weed in bloom. Dr. Huffaker is observing (back ground) the area where the weeds have already been eaten and destroyed by the imported Klamath weed beetles. Such stands of Klamath weed no longer exist on the range lands in California.

defoliating alfalfa caterpillars must be controlled and yet many chemical insecticides cannot safely be applied for they leave poisonous residues in the hay. Some of these residues may be on hay eaten by dairy cattle and the poisons may ultimately find their way into milk and butter. The alfalfa caterpillar can be controlled, however, by certain diseases which are specific to it. If suspensions of these disease organisms are applied in sprays to the alfalfa the caterpillars are killed and the hay can be fed safely to cattle.

Thus it is apparent that biological control may be employed against insects and weed pests, and the agents used may be parasites, predators, or pathogens. It is applied ecology in that it utilizes the natural forces which normally keep populations in check and maintain a balance of nature. It is an example of one of the many ways that man can use his growing knowledge of the biological world for his own well being.

Junior Awards Contest in Biology

Atlanta, Georgia

The Communicable Disease Center Branch of the Scientific Research Society of America is sponsoring an awards contest in biology for all 10th and 11th grade high school students in the city of Atlanta, Georgia.

The major purpose of The Contest is "to develop interest in the biological sciences, and to acquaint junior scientists with accepted procedures for planning and carrying out research projects."

The Contest closes April 27, 1955, and the awards consist of: First prize—$50.00; second prize—$30.00; third prize—$20.00. Certificates of Merit will be given to all contestants receiving honorable mention.

Suggested fields to aid in the selection of projects include: Discovery of New Antibiotics; Diseases of Animals Transmissible to Man; Relation of Airborne Organisms to Allergy; Laboratory Diagnosis of Disease; Arthropods in the Spread of Human Disease; and Sanitation in the Control of Disease. These broad categories are NOT subjects or titles for projects, but only fields from which appropriate problems may be chosen. Entries in other fields of biology can also be submitted.

Mrs. M. G. Brown, Science Coordinator of the Atlanta Schools is working with the RESA in giving help and assistance during or after this contest. Winners will be announced May 12, 1955.

WORKSHOP ON THE USE OF RADIOISOTOPES

A two-week Workshop on the Use of Radioisotopes in High School Science Teaching will be held at Iowa State Teachers College, Cedar Falls, Iowa, June 13-25, 1955. It will be conducted under the direction of the Science Department of the College with the technical assistance of the Atomic Energy Commission. The local staff will be augmented for lectures by visiting scientists who are authorities in their fields.

This is a pioneering attempt to meet the needs of high school teachers and teachers of beginning college science courses by providing them first-hand acquaintance with radioisotopes. The Workshop is planned with the idea that the use of radioisotopes for this purpose is both practical and safe. Lectures, audio-visual aids, and individual study will be used to present the subject. Participants will obtain direct experience with instruments and radioisotopes by laboratory work each day. Considerable attention will be given to developing experiments suitable for use by each teacher in his or her teaching position.

Enrollment in the Workshop is restricted to twenty-four participants in order to provide proper laboratory experience for each.

A grant from the Standard Oil Foundation, Inc. has made it possible to offer twenty scholarships.

Married teachers are invited to bring their wives. Housing for both will be provided for a limited number in one of the men's dormitories.

Address your inquiries to J. W. Kercheval, Science Department, Iowa State Teachers College, Cedar Falls, Iowa.

An ecological approach to the topic WEATHER can be presented to help stimulate student interest and, at the same time, provide an opportunity to integrate biology with other areas in the curriculum.

The Teaching of Biology in Danish Schools

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The school in Denmark consists of a primary school, an intermediary school, a secondary school and a gymnasium. The pupils of the primary school are from 7 to 14 years of age, but at the age of 12 they are allowed to choose whether they will pass on to an examination school or continue in the primary school. The intermediary school comprises 4 forms and is concluded with an examination, after which the pupils may leave or go in for a secondary school certificate (Realeksamen) or pass on to the gymnasium. The "Realeksamen" is passed after one year, the matriculation test after 3 years, the latter giving access to the higher education at the University.

Apart from the first two years at school, two weekly lessons in biology are generally given in all forms. At college, however, biology is not taught until the last form, but then 4 weekly lessons are given.

For the intermediary school the Ministry of Education has laid down a curriculum which leaves the teachers very great liberty in the choice of subjects as well as in their methods of teaching. In addition the teacher has the choice of several series of text books, some dealing with the animals on a systematic basis, with preference given to Danish animals; others are built up on a concentric system, i.e., instruction commences with several groups of animals, vertebrates as well as invertebrates, and in the following years these groups are supplemented by adding other species and also new groups. Finally some text books deal with the animals according to their habitat. Most of the text books are in a summary form, but other books may be chosen, with a more comprehensive rendering, so that they may be regarded rather as treatises or manuals for the study of zoology.

Most teachers endeavour to vary their instruction as much as possible. It will be no surprise to American teachers to learn that here in Denmark we also employ preparations (preparations preserved in liquids, insect boxes, skulls) of which class sets are available. Of other auxiliaries may be mentioned tables of illustrations, lantern slides and films. In addition the teacher will arrange small experiments, maintain an aquarium, a terrarium or an experimental beehive in the zoology class, keep a record on the blackboard based on observations by the pupils in nature, paste up on a poster board cuttings of biological interest from papers, etc., and arrange excursions or museum visits either during the lesson hour or for entire school days.

The number of books published in Denmark on biology teaching in the intermediary school is only small, so most teachers must find out for themselves which are the subjects most suitable for the individual tasks of the pupils or what is the best way to make use of the films available.

The principle object of the instruction must be said to be the awakening or maintenance of the interest of the pupils for living Nature, and not so much to convey to them an extensive knowledge which would be apt to be lost again if not employed or further developed by continued instruction. Accordingly the cramming with systematics and anatomy is not so important, although tasks on systematics and anatomy are given; for instance by letting the pupils compile a schedule setting out the variations in the anatomy of Danish toads, or letting them try to find out differences and analogies between spiders and insects. They are also taught how to distinguish between the skulls of the different carnivori by means of the teeth, for instance by testing the knowledge of the pupils on skulls, which they have, themselves, collected.

In the intermediary school interest for zoology is great, but on the other hand botany takes a secondary place. Instruction is rarely systematical, but certain types of plants, wild or cultivated, are dealt with on

the basis of living material. An easy school flora manual is used, and the pupils obtain some knowledge of plant physiology and plant societies.

In the intermediary school the curriculum ends with a course on human physiology and anatomy with special stress on hygienics. This subject is approached by most pupils for the first and only time at school, and it is therefore not strange that most of them are very much interested and that much time is devoted to the subject.

It has become customary at many places that at some time during the intermediary school, a form spends a week in school-camp. In this a strong appeal is made to the self study of the pupils and their observation of living material in its natural surroundings. They endeavour to perform observation tasks in Nature, for instance the heronry, the animal life of the beach, spiders etc., by replying to printed questions. Attempts have also been made to introduce this system of working in the daily instruction on the basis of preparations and books.

In the "Realklasse," the form which finishes with the test for the secondary school certificate, instruction was formerly given in the anatomy and systematics of the Vertebrata and in certain characteristic plant families, but now most schools instruct in biology on the same lines as in the gymnasium, but not quite as thoroughly.

The biology instruction in the gymnasium comprises two subjects: general biology and human physiology. In biology the course includes: the cell, vital functions, the structure of plant and animal tissue, propagation, some ecology, heredity and palaeontology. Instruction is largely based upon self study by the pupils, who make experiments by themselves and examine, under the microscope, preparations either made by themselves or already available. It is also a general practice that the teacher, aided by the pupils, arranges big experiments such as Mendelian mutations of the banana fly or the hatching of hen's eggs in an incubator. Human physiology is studied from a manual by the late Nobel-Prize winner Professor A. Krogh, who wrote the first edition when the subject was introduced into Danish colleges some 50 years ago. As a natural link in the instruction the subjects of sexual physiology and hygienics are included, but any teacher of biology in the intermediary school is allowed to go through these subjects.

At the Matriculation Test biology may be left out, but if it is made a subject of the examination, the Ministry of Education will always delegate an examination judge. Only one question is given, but it is endeavoured to form the questions in such a manner that they have a bearing on the different branches of the subject. A question on "carbonic hydrates," for instance, will deal with chemistry, formation in green plants, the structure of which is touched upon, human digestion and oxidation in the body.

Although I have unfortunately not had the opportunity to watch American biology instruction, I have an idea that one difference between that and our instruction is that in the gymnasium we not only endeavour to create interest in the subject and thereby animate to self-study by the pupils, but we also make certain demands of exact knowledge and understanding, which are tested by a final examination.

GUIDE SHEET FOR THE ROOKERY AND THE HERONRY

BRING WITH YOU: A map and collecting box.

1. What is the name of the forest?
2. Make *at home* with the aid of the map a sketch of the forest. N. S. arrow.

THE ROOKERIES. (*Corvus frugilegus*)

3. Indicate on the sketch-map the locations of the rookeries in the forest.
4. In what kind of trees are the nests placed?
5. In which part of the tree-tops are the nests placed?
6. Count the number of nests in the rookeries.
7. What is the greatest number in one tree?
8. What is the material of the nests? Examine a fallen-down nest.
9. From where have the rooks brought the material for the nests?
10. Why are the nests not of equal size?
11. What is the effect on the ground of the many nests with young birds above it?
12. Collect feathers, down and egg-shells.

13. In which manner do the birds react on our visit?
14. How is the sound of their voice?
15. Note during the following days when and how you see rooks at other places and what they are doing.

THE HERONRY (*Ardea cinerea*)

16. Indicate on the sketch-map the location of the colony in the forest.
17. What is the difference between the sound in the rookery and the heronry?
18. In what kind of trees are the nests placed?
19. In which part of the tree-tops are the nests placed?
20. Why have the nests been placed in this manner?
21. What is the material of the nest? Examine a fallen-down nest.
22. Why has the nest fallen down?
23. Why are the nests not of equal size?
24. What is the total number of nests you can count?
25. What is the greatest number in one tree?
26. How are the shrubs of the undergrowth and the ground affected by the great number of inhabited nests above?
27. Collect egg-shells (colour?), feathers, down, gulp (contents?), dropped food (description?).
28. What are the young ones in the nests doing?
29. What are the grown-up herons doing?
30. How does the heron keep its neck during flight?
31. Do the grown-up herons and the young make use of their voice? How does it sound?
32. Note during the following days where and when you see herons at other places and what they are doing.

Literature: The School-camp in Northern Seeland 1949.
Holstein: The Grey Heron

New Assistant Editor Appointed

Mr. Brinton Miller, who is working on antibiotic research at Purdue University, has accepted appointment as an assistant editor on the staff of *The American Biology Teacher*. Mr. Miller will be mainly concerned with helping the Co-Editors prepare manuscripts for publication.

The Anchor-Man in General Education

JOHN P. DECKER
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Nearly every collegiate scientist has or will come face to face with the problem of general education, the problem often being in the form of a vociferous prophet or faddist who has a sure-fire prescription for turning out the ideal, the Broadly-Educated Man. Rarely does one find fault in the broad objectives of such a prescription. Most of us are, after all, more or less in favor of virtue as opposed to sin. The debatable points are to be found mostly among the techniques suggested for achieving the broad objectives. The grosser defects in such proposals can be detected easily by examining them in the light of the anchor-man principle.

The development of mental maturity is the essence of general education. The student does not necessarily grow in mental maturity because of exposure to any particular course of study. Rather it probably "rubs off" onto him as a result of contact with impressive minds among the faculty—the anchor-men.

Each of us is a walking, documented case history of how mental maturity is or is not developed. If one looks back over the history of his own development he will find that there are several persons who stand out as giants, the anchor-men, those who have had a real effect on his mental growth. They were impressive because their maturity was genuine and obvious. They did not have to tell one the way to do, to think, or to live, for the demonstration was clear, convincing and unmistakable.

Only a very few persons can become outstanding anchor-men for many students. Yet each of us can become an anchor-man, in a small way, and make our own lives and the lives of others richer in the process. If an instructor has the earned (not just legislated) respect of his students, each contact may have some effect on their trend toward men-

tal maturity. He should reflect on his student contacts carefully, humbly and repeatedly. He can do this by asking himself a few simple questions about the major categories of mental maturity:

1. Clear thinking. Do you understand a systematic and effective scheme for solving real problems? Do you give opportunity for guided practice?
2. Communication. Do you appreciate the value of being able to speak and write effectively? Do you practice the principles of lucid, succinct speech and lucid, succinct writing? Do you give opportunity for guided practice?
3. Philosophy. What are your own life goals? What do you need to be happy? What are those things in the dark corners of your mind that make you unhappy and sour? Do you ever recognize an opportunity to encourage students to think about, question and clarify their goals?
4. Human dignity and rights. Do you see your student as a fellow human being having the same dignity and rights you are so jealous of in yourself? Do you honestly believe that the student's problems, fears, desires and joys are just as real and powerful as yours? Do you recognize opportunities to demonstrate (not just talk about) your convictions?
5. Citizenship. Do you feel that politics is a decent and essential part of American life? Do you participate? Have you ever been able to divert a political discussion from a cynical level to a wholesomely inquiring level?

One final question seems to be in order: How well are you doing as an anchor-man?

Test Tube Stomach

A test tube stomach has been devised to measure the nutritive value of whey, a by-product of cheese-making, Dr. Robert M. DeBaun, a research biochemist at National Dairy Research Laboratories, Oakdale, N. Y., reported. Many laboratory animals have been spared by the new laboratory method, which reproduces in part the action of digestive enzymes in animals.

Some General Principles of Conservation Education

J. W. GALBREATH
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There have been several published lists of principles in biology and science, and many of them have been included in text books of science.

It now seems that we need a set of general principles for conservation. There have been several books appearing recently on the subject of ecology and conservation, but, to my knowledge, we have no combined list of conservation principles.

With this thought in mind, the author has sifted some of the recent literature in an attempt to glean the main principles pertaining to the teaching of a fundamental understanding of conservation education.

This list is not complete—nor would I maintain that it is perfect, but I feel that it is a beginning.

In teaching conservation correlated with other subjects or as a special subject, I believe understanding, applying, and practicing these principles will go a long way in creating the right thinking toward conservation in America today.

I have used these principles in biology and in conservation, which we teach as a one-half unit course in the 12th grade.

Many false theories are still operating today, and they must be corrected in our teaching if wholesome attitudes toward our natural resources are ever attained.

I welcome comment from anyone who is teaching conservation as a special subject or correlating it with other courses in an attempt to improve this list.

CONSERVATION PRINCIPLES

1. *Adaptation:* Every living thing must adapt itself to its environment if it is to live successfully. This includes man.
   (a) We are tied to our environment.
2. *Interdependence:*
   (a) All living things are dependent on one another; man is no exception.

(b) The web of life: Living things exist in a highly complex web of life. This balance, if attained, is never constant. Nature is constantly using a system of checks and balances.
(c) Ecology is the basis of man's combined welfare on the earth.
(d) Man is constantly upsetting Nature's balances.
(e) Conservation problems, for the most part, are man-made and can be solved by man.

3. *Succession:* Nature is never constant, life is constantly shifting; upward toward a climax; or downward toward extinction.
(a) Competition or co-operation is always involved.
(b) Change is the natural order.

4. *Stewardship:* Man is only a trustee or steward of the land, responsible for the welfare of future generations.
(a) No single generation has the moral right to exhaust a natural resource.
(b) Conservation is ethical as well as economical.
(c) Conservation is the conscience of science.
(d) Conservation is learning to live in harmony with Nature's laws.
(e) Nature's laws cannot be changed.
(f) All living things, man included, either directly or indirectly depend upon the soil for life.
(g) Resources may be renewed and made more productive with use.

5. *Multiplication:*
(a) Nature is prolific.
(b) Nature is wasteful.
(c) Limiting factors or controls are always in operation.

6. *Generalization:* Man holds within himself the power to co-ordinate knowledge into understanding and build within his heart the incentive and wisdom to use new found powers wisely and with responsibility, for the common good.
(a) Material expansion alone is not enough. We must be spiritually right.
(b) World leadership depends upon an abundant supply of natural resources.

7. *False Theories Regarding our Natural Resources:*
(a) Natural resources are inexhaustible.
(b) Nature is our enemy to be conquered.
(c) There is no limit to our technological expansion.
(d) Our standard of living can continue upward forever.
(e) We can change Nature's laws.

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NORTH CENTRAL CONFERENCE ON BIOLOGY TEACHING TO BE HELD AT UNIVERSITY OF MICHIGAN BIOLOGICAL STATION

The North Central Conference on Biology Teaching sponsored by the National Association of Biology Teachers on a grant from The National Science Foundation, will be held at the University of Michigan Biological Station at Douglas Lake, Cheboygan, Michigan, August 19-30, according to Brother Charles H. Severin, President of NABT, St. Mary's College, Winona, Minnesota.

Ninety delegates will be selected from high schools, colleges and state departments of education in Michigan, Ohio, West Virginia, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri and Kansas.

The staff selected for the Conference includes Dr. Richard L. Weaver, as Director, University of Michigan, Ann Arbor, Michigan; Dr. John Breukelman as Chairman of the Steering Committee, State Teachers College, Emporia, Kansas; Dr. Richard R. Armacost, Purdue University, West Lafayette, Indiana; Paul Klinge, Howe High School, Indianapolis, Indiana; and Dr. Alfred H. Stockard, Director of the University of Michigan Biological Station, Ann Arbor, Michigan.

This is the second conference sponsored by NABT and The National Science Foundation. The Report of the Southeastern Conference held in 1954 at the University of Florida, was published as the January issue of *The American Biology Teacher*. Single copies are available from Paul Webster, Secretary-Treasurer, NABT, Bryan High School, Bryan, Ohio.

A Special Course in Radioactivity For Secondary School Science Teaching

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